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THE EUROPEAN SPRUCE SAWFLY

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The European spruce sawfly (Diprion polytomum Hartig), which is a relatively harmless insect in Europe, has caused great damage to spruce forests in the Gaspé Peninsula, Quebec, Canada. Defoliation by this sawfly first became noticeable in this region in 1930, but the insect itself had probably been present there for many years. Since 1930 thousands of square miles have been infested, and recently the distribution has been reported by Balch, of the Dominion Entomological Branch, to be from Nova Scotia west to Lake Temiskaming in northwestern Ontario. Heavily infested areas have also been found north of the Saint Lawrence River, in Quebec. In 1932 there was heavy mortality of spruce in the Gaspé region due to the combined attacks of this sawfly and the eastern spruce bark beetle (Dendroctonus piceaperda Hopk.). In some localities from 40 to 50 percent of the spruce is already dead. Balch estimates that "about 52 percent of the volume of the white spruce is dead, 28 percent is practically certain to die, 20 percent might recover if the attack stopped. Of the black spruce, 22 percent is dead, 12 percent beyond recovery, and 66 percent capable of recovery failing further injury." These figures are considered as a fair average for the heavily infested area of the peninsula.

Records of the presence of this insect in the United States show that adult flies were taken on Mount Washington, N. H., in 1929 and on Mount Desert Island, Maine, in 1931. Larvae were collected at North Andover, Mass., in 1931, and one adult emerged the following spring. An extensive survey conducted by the Bureau of Entomology and Plant Quarantine in 1935 indicates that the insect occurs generally over the northeastern part of the United States, as far south as Long Island Sound and as far west as western New York. Heavy infestations, over small areas, in northwestern Connecticut and in the Adirondack Mountains indicate that the insect has been present in these areas for some years.

The European spruce sawfly attacks not only all three spruces native in the eastern part of the United States, the red spruce (Picea rubra Link), the black spruce (P. mariana (Mill.) B. S. P.), and the white spruce (P. glauca Voss), but also the imported Norway spruce (P. excelsa Link); and laboratory experiments indicate that the larvae will feed readily on Colorado blue spruce (P. pungens Engelm.). The further spread of the insect to the south and west will depend largely on the prevalence of planted spruce, both in plantations and as individuals, although the native red spruce grows in the southern

Appalachian region on the higher slopes. Canadian studies indicate that the adults can fly well over a mile, and, aided by favorable air currents, they might be carried considerable distances.

The adult female has four wings, is rather stout, and is black with yellowish markings on the abdomen, thorax, and front of the head. Up to the present time males have not been found in the United States, and reproduction is, therefore, parthenogenetic. The eggs, which are laid singly in slits in the needles, are about 2 mm long. They hatch in about a week, and the larvae begin feeding, usually at the tips of the needles. The first- and second-instar larvae are about 3 mm long, but the body in the second instar is a little thicker than that of the first. They gradually increase in length until at the end of the fifth instar they average about 20 mm. The larvae are light green in color, and in the fourth and fifth instars five narrow longitudinal white lines are clearly discernible. They have, in addition to the 3 pairs of true legs, 8 pairs of abdominal prolegs, and this readily distinguishes them from moth larvae, which have from 2 to 6 pairs. The resemblance of the larvae in all instars to the needles renders them very inconspicuous, and in a light infestation it is difficult to see even the larger ones. Their presence can best be discovered by jarring the limbs and catching the larvae on a sheet spread under the tree.

As a general rule the larvae feed on the old needles, but when the needles of the current season have matured these also will be eaten. Defoliation is generally heavier in the lower part of the crown, and heavy feeding causes a distinctly thinned appearance. The larvae feed singly at all times, and most of the feeding damage is done by those of the fourth and fifth instars. The characteristic feeding is shown in figure 1. Canadian studies have shown that complete or nearly complete defoliation is necessary to kill the average spruce tree, but in many cases death will not occur for several years.

When the larva changes to the sixth and final instar, feeding apparently ceases, the longitudinal lines disappear, and the alimentary tract is evacuated just before the larva enters the duff to spin its cocoon. The cocoon is golden to dark brown in color and is about 10 mm in length. Figure 2 shows the adult female, cocoons, and large larvae. Transformation to the pupa and adult takes place in the cocoon, which is normally spun in the duff just above the mineral soil. Larvae of the summer generations, however, may on rare occasions spin the cocoons on the twigs, as is the case with the second generation in Europe.

Under laboratory conditions the period of development from egg to adult may be as short as 6 weeks. Laboratory studies show that temperature and humidity may have an important bearing on the length of the cocoon period. The species has one generation annually in the Gaspé region and two in New Brunswick; in northern Maine probably one generation, and in the rest of New England at least two. In the southern part of its range it may have as many as three, and a partial fourth, when weather conditions are favorable.

Control of this sawfly in forested areas is difficult. As all sizes and ages of spruce are attacked, and as natural and planted stands and individual trees are equally susceptible, reduction of the damage by silvicultural practices does not appear promising. It is believed that breeding and liberating large numbers of parasites before the insect has multiplied to epidemic proportions may bring best results. Preliminary work on this phase of control has already been started in the United States and will be continued in 1936. Predatory insects, such as the common soldier bugs, are known to attack this insect and they may prove of considerable value. Shrews, ground-feeding rodents, squirrels, and probably ground-feeding birds account for the destruction of considerable numbers of the cocoons in the litter, and in at least one case in Connecticut the infestation has been reduced by the activities of shrews and moles. Weather conditions late in the fall undoubtedly cause mortality of great numbers of larvae. Freezing temperatures during the latter part of November 1935 killed the young larvae of the fourth generation in southern Connecticut.

Preliminary work with insecticides indicates that good control may be effected by spraying with acid lead arsenate at the rate of 3 pounds to 100 gallons of water, with one-fourth pound (about 4 fluid ounces) of fish oil or linseed oil added as a sticker for each pound of lead arsenate. Good results may also be obtained by the use of a derris spray, made by mixing 1 part of powdered derris (containing 4 percent of rotenone) with 500 parts (by weight) of water, and adding $2\frac{1}{2}$ to 5 parts (by weight) of fish oil or raw linseed oil as a sticker (e.g., $1\frac{2}{3}$ pounds of derris, 100 gallons of water, and from $\frac{1}{2}$ to 1 gallon of sticker). The use of insecticides, while not practical in forest or plantation, is justified in protecting ornamental spruce.

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Figure 1.--The characteristic feeding of the European spruce sawfly.

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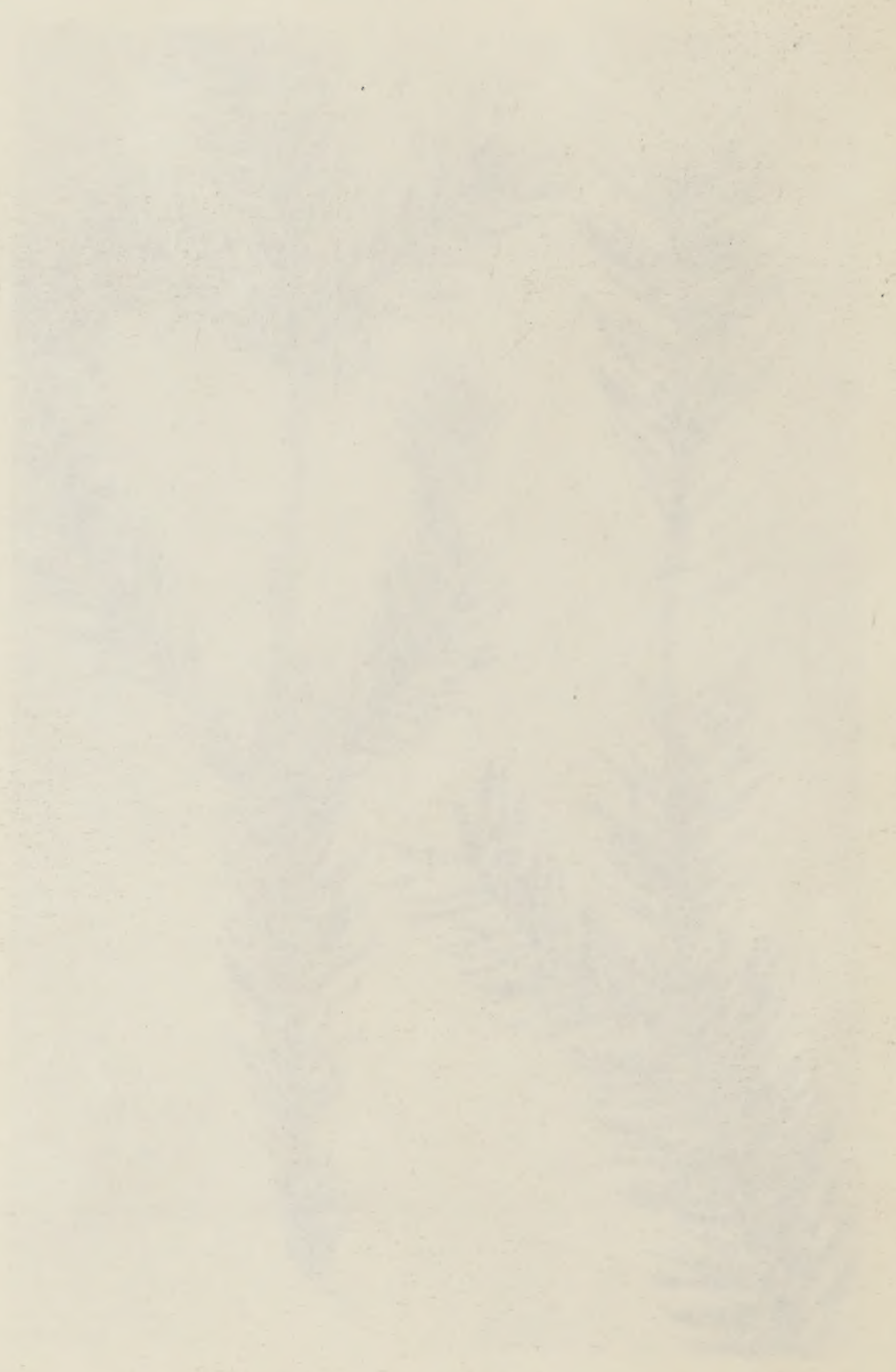


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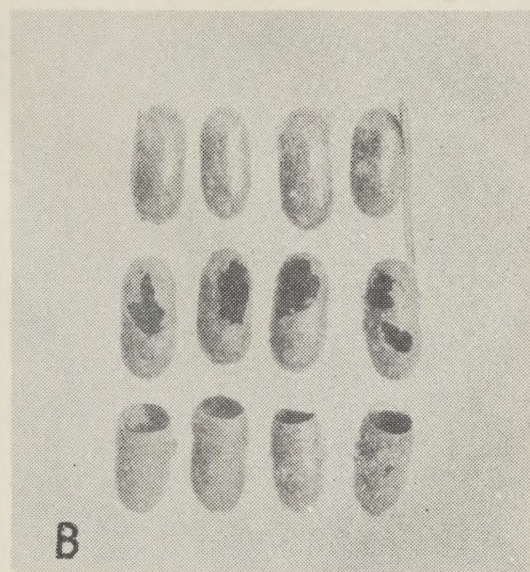
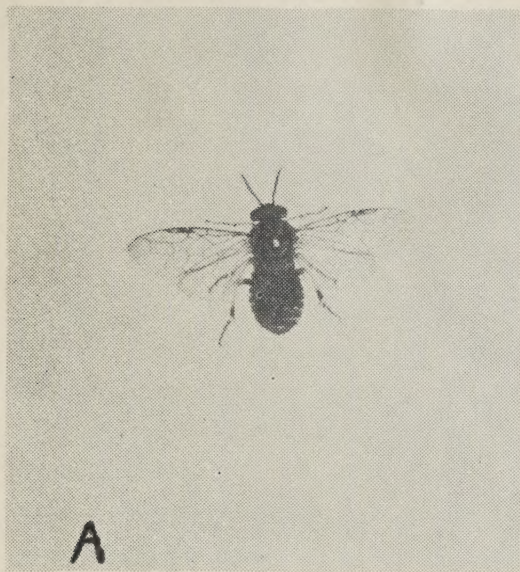


Figure 2.--A, Adult female (enlarged 2 diameters). B, Cocoons (enlarged 2 diameters); those in the top row contain living larvae or pupae, those in the middle row were opened by shrews, and those in the bottom row are empty, the adults having emerged. C, large larvae feeding (about natural size). These photographs were furnished by the Connecticut Agricultural Experiment Station.

